Claims

1. A method for fabricating a spacer of a gate structure, the method comprising:

performing a first etch process implementing a first etchant gas, the first etch process configured to implement an interferometry endpoint (IEP) detection method to detect a removal of a portion of a spacer layer having a specific thickness;

discontinuing the first etch process upon removing the portion of the spacer layer, leaving a thin spacer layer;

performing a second etch process implementing a second etchant gas, the second etch process configured to remove the thin spacer layer; and

discontinuing the second etch process when the second etch process has continued for a predetermined period of time;

wherein the second etch process is configured to remove the thin spacer layer, leaving the spacer for the gate structure.

2. The method of claim 1, wherein the second etch operation is configured to be monitored by a non-IEP etch endpoint monitoring method.

3. The method of claim 1, wherein the IEP etch endpoint monitoring method is configured to monitor a photon beam reflected by the spacer layer so as to determine the thickness of an etch depth during the first etch operation implementing the distance between consecutive maximum intensities.

4. The method of claim 2, wherein the non-IEP etch endpoint monitoring method is optical emission spectroscopy (OES).

5. The method of claim 1, wherein the spacer layer is a nitride layer.

6. A method for fabricating a spacer of a gate structure, the method comprising:

performing a first etch process implementing a first etchant gas, the first etch process configured to implement an interferometry endpoint (IEP) detection method to detect a removal of a portion of a spacer layer having a specific thickness from over the surface of the substrate, leaving a thin spacer layer; and

performing a second etch process for a predetermined period of time implementing a second etchant gas;

wherein the second etch process is configured to remove the thin spacer layer, leaving the spacer for the gate structure.

7. A method for forming a silicon nitride spacer, the method comprising:

depositing a silicon nitride spacer layer over a substrate having a gate structure formed thereon;

performing a first etch operation on the silicon nitride spacer layer in a plasma chamber;

monitoring a light reflected by the silicon nitride spacer layer;

stopping the first etch operation so as to leave a thin spacer layer over the surface of the substrate and the gate structure formed thereon;

purging a first plasma content defined within the plasma chamber;

performing a second etch operation in the plasma chamber, the second etch operation configured to remove the thin spacer layer;

monitoring an optical signal produced by a second plasma during the second etch operation; and

discontinuing the second etch operation once the second etch operation has continued for a predetermined period of time,

wherein performing the first etch operation and the second etch operation are performed *in situ* so as to control a shape of nitride spacers and a removal of the spacer layer .

8. The method of claim 7, wherein monitoring the light reflected from the surface of the substrate includes,

directing a photon beam onto the nitride spacer layer;

observing a photon beam reflected by the nitride spacer layer; and

determining an etch depth as the first etch operation proceeds.

9. The method of claim 8, wherein determining the etch depth includes:

monitoring an intensity of the reflected light;

determining a distance between a pair of consecutive maximum intensities; and

determining the thickness of the etch depth implementing the distance between consecutive maximum intensities.

10. The method of claim 7, wherein performing the first etch operation in the plasma chamber includes:

introducing a first etchant gas into the plasma chamber; and

powering up the plasma chamber to strike the first plasma to commence the first etch process.

11. The method of claim 7, wherein performing the second etch operation in the plasma chamber includes:

introducing a second etchant gas into the plasma chamber; and

powering up the plasma chamber to strike the second plasma to commence the second etch operation.

12. The method of claim 7, wherein a thickness of the thin spacer layer is configured to range between approximately about 50 Å and 300 Å.

13. The method of claim 7, wherein a thickness of the thin spacer layer is configured to range between approximately about 100 Å and 200 Å.

14. The method of claim 7, wherein a thickness of the thin spacer layer is configured to be about 100 Å.

15. The method of claim 10, wherein the first etchant gas is one of a combination of C_2F_6, CH_2F_2, and O_2, a combination of CF_4, CH_2F_2, and O_2, and a combination of CF_4, HBr, and O_2.

16. The method of claim 11, wherein the second etchant gas is one of a combination of C_2F_6, CH_2F_2, and O_2 and a combination of O_2, HBr, and SF_6.

17. An *in situ* dual-stage etch endpoint detection system, the system comprising:

an etch chamber configured to include an electrostatic chuck (ESC), a top electrode, and a bottom electrode, the ESC being configured to support a wafer having a spacer layer formed over a gate structure;

an interferometry endpoint (IEP) monitoring system configured to monitor a photon beam reflected by the spacer layer during a first etch operation; and

a non-IEP endpoint monitoring system configured to monitor a second etch operation by monitoring an etch time;

wherein a first etch operation implementing the IEP monitoring system is configured to be discontinued so as to leave a thin spacer layer to be etched during the second etch operation.

18. The system of claim 17, wherein the non-IEP etch endpoint monitoring system is configured to implement optical emission spectroscopy (OES) to monitor the second etch operation.

19. The system of claim 17, wherein the IEP monitoring system is configured to monitor a photon beam reflected by the spacer layer so as to determine the thickness of an etch depth during the first etch operation implementing the distance between consecutive maximum intensities.

20. The method of claim 17, wherein the first etch operation implements a etchant gas configured to be one of a combination of C_2F_6, CH_2F_2, and O_2, a combination of CF_4, CH_2F_2, and O_2, and a combination of CF_4, HBr, and O_2 and the second etch operation implements a second etchant gas configured to be one of a combination of C_2F_6, CH_2F_2, and O_2 and a combination of O_2, HBr, and SF_6.